TC405/851 CONTROLLER

USER MANUAL

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TOUCH SCREEN LCD MODULE HANDLING PRECAUTIONS

The following precautions will guide you in handling of our product correctly:

1. Liquid crystal display devices:
   1.1. The liquid crystal display device panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock on LCD and touch screen. Should the glass break, handle it with care.
   1.2. The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.
   1.3. Wash your hands or clothes if you touch liquid crystal!

2. Avoid Static electricity!
   2.1. When working with the module, use your naked or gloved hand and wear non-conductive work suit to prevent generating static electricity by friction. ESD ground straps should be utilized.
   2.2. Be sure to ground any electrical appliances you may be using, such as soldering iron, cutting pliers, tweezers, etc.
   2.3. Floors, doors, and work tables must be grounded to discharge electricity.

3. When the LCD module alone must be stored for long periods of time:
   3.1. Protect the modules from high temperature and humidity.
   3.2. Keep the modules out of direct sunlight or direct exposure to ultraviolet rays.
   3.3. Protect the modules from excessive external forces.

4. Use the module with a power supply that is equipped with an over current protector circuit, since the module is not provided with this protective feature.

5. Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap.

6. Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used.

7. Do not stack up modules since they can be damaged by components on neighboring modules.

8. Do not place heavy objects on top of the product. This could cause glass breakage.

9. Do not scratch LCD or touch screen!

10. In order to maintain module reliability, do not touch or hold by the connector area.

11. Avoid any bending, pulling, or other excessive force on flexible cables, which can result in broken connections.

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PREFACE

About This Manual

This user's manual describes the function and operation of the TC405/851 controller Firmware rev. A and higher. This manual will help you quickly set up the touch screen controller evaluation board and its accompanying software, so that you can rapidly test and evaluate their usefulness for your application.

If You Need an Assistance

If you have any questions about this evaluation board, feel free to e−mail TVI Electronics Support Team at support@tvielectronics.com. Include the product name in the subject heading.

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Notice to Users

When a system failure may cause serious consequences, protecting life and property against such consequences with a backup system or safety device is essential. The user agrees that protection against consequences resulting from system failure is the user's responsibility. This device is not approved for life-support or medical systems.

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1. FUNCTIONS AND STRUCTURE

1.1. GENERAL

The TC405/851 is an intelligent LCD controller with an integrated touch screen control that supports Optrex F-51405 and F-51851 Series 240x64 COG Monochrome STN Graphic LCDs. This controller allows user to individually control each display pixel. This independent pixel control allows user displaying both text and pictures simultaneously. The TC405/851 uses an ATMEGA32 microcontroller and 4M bit AT45DB041B Flash. The microcontroller can be reprogrammed at any time by using AVRISP device.

1.2. FEATURES

1.2.1. RS-232 communication interface with nine programmable baud rates

The TC405/851 controller has RS-232 protocol interface. Communication parameters are: 8 Bit, No Parity and 1 Stop Bit. The TC405/851 controller is shipped set at 9600 baud rate. The baud rate can be changed by a command and stored. A 10 pin IDC connector on board allows communication with PC through the 9 pin DB connector. TVI Electronics ships the adapter cable with each TC405/851 controller. A footprint for an optional RS232 connector is available at J10. A serial TTL interface is supplied at J7.

1.2.2. Optional Bluetooth communication interface

The TC405/851 controller has an optional wireless communication interface for Sena Parani-ESD100 or Parani-ESD110 OEM Bluetooth Serial Modules.

1.2.3. 4Mb flash memory

4M bites of Flash Memory are divided into 2048 pages of 256 bytes each. The lower 40 pages of this memory contain text fonts used to display text. The remaining memory can be used to store up to 250 full-screen images. A utility program allows converting and downloading bmp and jpg images with 240x64 pixels resolution to display.

1.2.4. Touch screen controller

The touch screen controller can respond by sending X and Y coordinates of touch screen contact location or by sending digits (if used as a 6x3 keypad) to main microprocessor or computer. The TC405/851 controller can produce a sound on touch. In 6x3 Keypad Mode, the screen is divided on 18 boxes 37x18 pixels each. Controller sends digits from 1 to 18 according to the touch location. Each box response can be disabled or enabled. 6x3 Keypad Mode provides a Flip option which reverses colors of the touched box. The TC405/851 controller provides a touch screen calibration routine for more accurate results.

1.2.5. AVRISP interface

AVRISP (In-System Programmer) interface allows user to program own code into microcontroller, AVRISP device is required.

1.2.6. Draw/Clear Line/Rectangle/Circle

The TC405/851 controller simplifies drawing and clearing of horizontal, vertical and skew lines and shapes, such as rectangle and circle.

1.2.7. Voltage regulator

The TC405/851 has a built-in voltage regulator with input 7 - 20 VDC (connectors J8, J9) and output 5 VDC (connector J12). The voltage regulator is capable to provide up to 1A current for external applications. 5V power may be applied to J12 eliminating the need for an onboard voltage regulator.

1.2.8. Multiple display modes

The TC405/851 controller supports multiple display modes (Normal, Reverse, Mixed) that can be freely mixed on F-51405 and F-51851 LCDs.

1.2.9. Software control

Software allows controlling LCD contrast, backlight ON/OFF and display ON/OFF.

1.2.10. Hardware contrast adjustment

The TC405/851 controller has a trimmer potentiometer (R11) for contrast adjustment. If you are not satisfied with the default contrast settings, use R11 to adjust the settings.

1.2.11. Buzzer

The TC405/851 controller has a built-in buzzer for sound producing.

1.2.12. Animation

The TC405/851 controller allows auto alternation of images previously stored in a Flash.

1.2.13. Fonts

The TC405/851 controller supports 4 built in font sizes: 7 pixels (H), 14 pixels (H), 14 pixels (H) Bold and 22 pixels (H). The bmp font files are stored as screens 1-5 in controller's memory. Different font sizes can be freely mixed on the screen.

1.2.14. Firmware update

The TC405/851 controller’s firmware can be updated through the serial port.

1.3. POWER REQUIREMENTS

Power to the TC405/851 is derived from the external power supply through either J8 or J9 connectors. Voltages of 7 VDC to 20 VDC must be supplied through J8 or J9 (optional) connectors. Since it is regulated on the TC405/851, this input voltage does not need to be regulated as long as it falls within this range. Voltage of 5 VDC regulated can be supplied through J12.

* Make sure the polarity is correct! Reversed power will damage the device and/or power supply!

2. GETTING STARTED

This chapter guides you through the hardware connection, powering up the TC405/851 controller and setting up the software for initial testing.

2.1. HARDWARE CONNECTION

The controller mounts directly to the back of the display utilizing the four latches on the corners of the display. When handling the display and controller make sure to follow the static precautions.

With the display face down and the two data connectors facing away from you rout the backlight cable, so it exits the lower right side of the display.

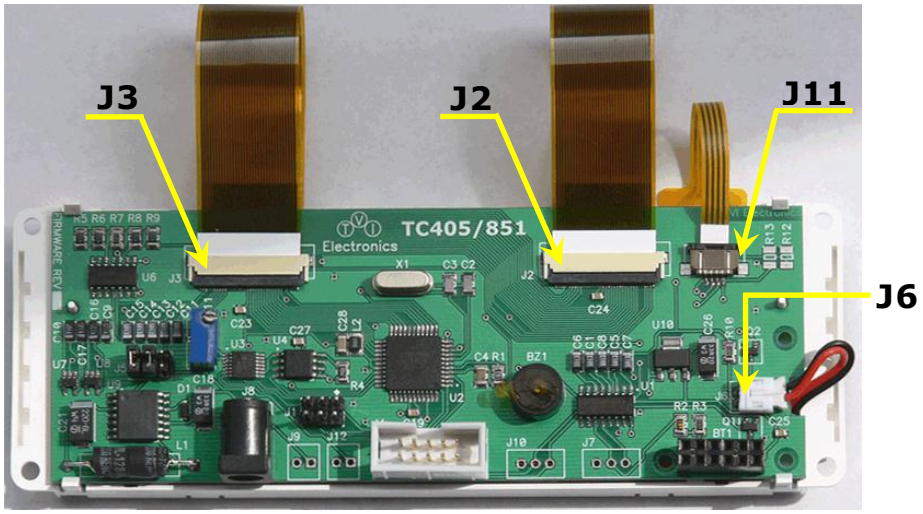
Figure 2-1: LCD Backlight Cable Routing

Carefully align the two plastic pins on the display to the controller board and snap the board in place. Make sure the backlight wires are lined up with the slot in the controller or the board will not seat properly.

Carefully open the two LCD connector latches J2 and J3 by pulling the brown latches outwards. Insert the flat data cables into the connectors being sure the cables are fully seated. After seating the cable push the latches back in being sure both ends are pushed all the way in. Insert the backlight cable into connector J6.

If you have a touch screen carefully pull the latch on connector J11 out. Insert the touch screen cable into J11 being sure it is seated, push the latch back in.

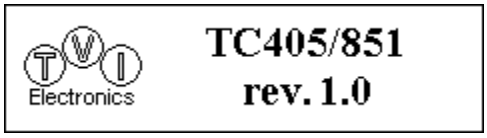
Figure 2-2: Hardware Connection



2.2. POWER-UP

Connect a power supply to J8 power jack; make sure the polarity is correct. Screen #6 is the power up screen which will be displayed each time the unit is powered up. The power up screen can be customized through Control Panel 240x64 software. The factory default will show TVI Electronics logo and current controller firmware revision as shown on Default Power-Up Screen below.

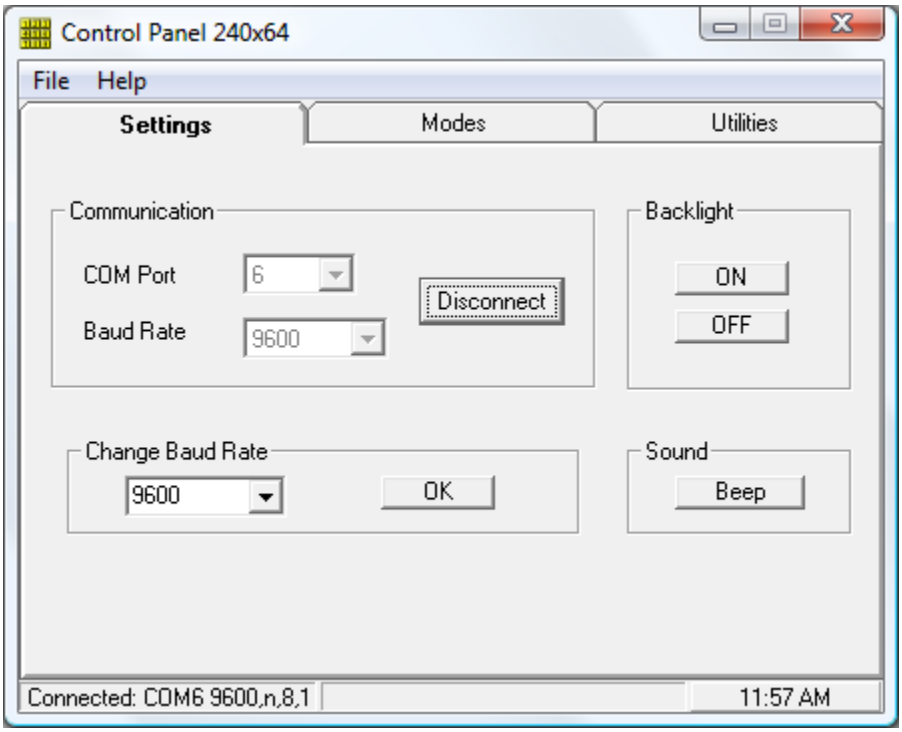
Example 2-1: Default Power-Up Screen



2.3. QUICK START

Download and install Control Panel 240x64 software on your PC. Follow instructions that the installer gives you. When installation is complete, connect a serial cable from your PC to the TC405/851 controller. Once this connection is made, launch the Control Panel 240x64 software on your PC. Select the appropriate COM Port, Baud Rate (default 9600), and click Connect. Now you may begin using the software to evaluate the TC405/851 controller board.

Figure 2-3: Default Software Screen



3. OPERATION

This chapter describes each function of TC405/851 controller.

3.1. TC405/851 CONTROLLER CONNECTION

Figure 3-1: TC405/851 Controller Board Layout

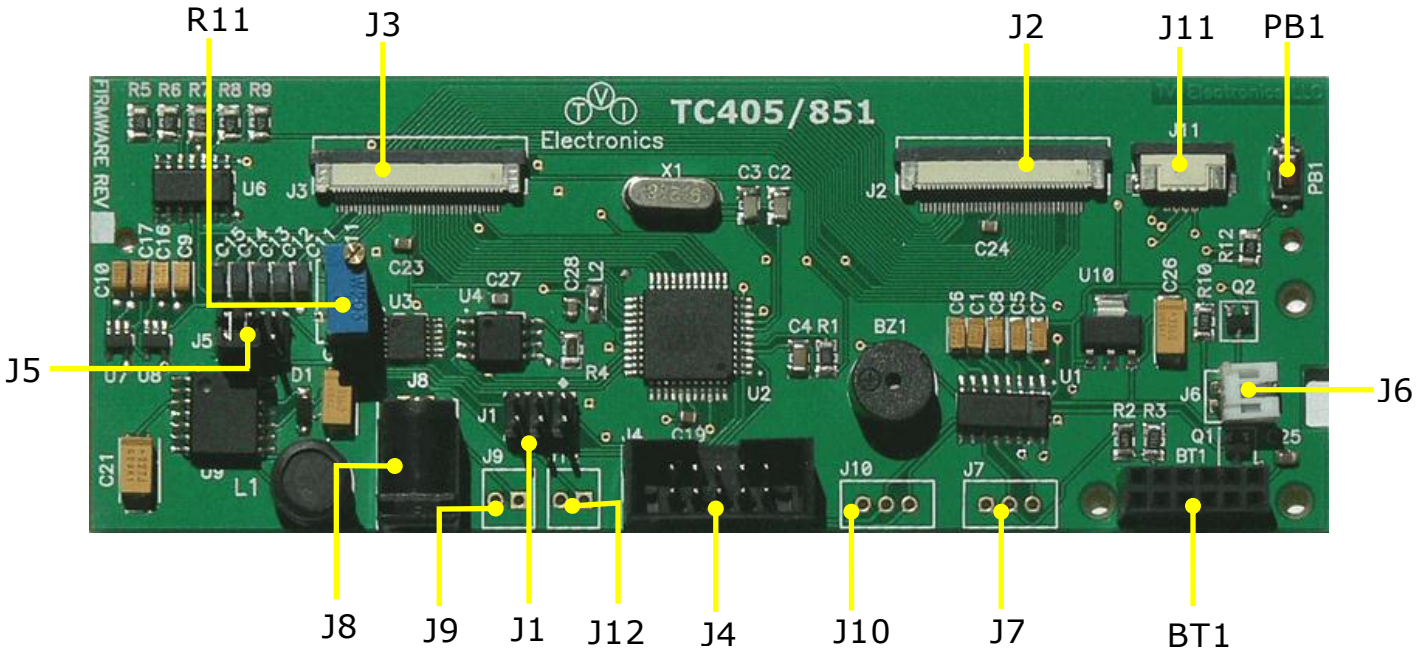


Figure 3-2: J5 Jumpers

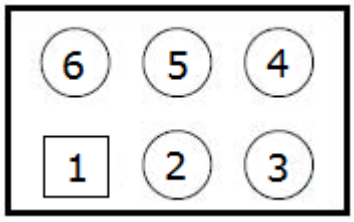


Figure 3-3: J7 Pin Out

Figure 3-4: J8 Pin Out

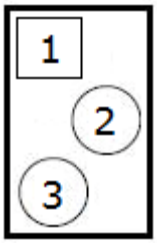


Figure 3-5: J9 Pin Out

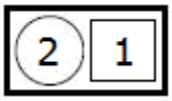


Figure 3-6: J12 Pin Out

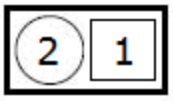


Table 3-1: J5 Jumpers

PIN #	Function	Subsection
1,6	Default Baud Rate 9600	3.1.1
2,5	Power through J8 or J9	
3,4	Power through J12	

Table 3-2: Headers

Reference Designator	Function
J1	AVRISP Interface
J4	RS232 Interface
BT1	Sena Parani-ESD100 or ESD110 Interface

Table 3-3: Connectors

Reference Designator	Function
J2, J3	F-51405 / F-51851 LCD Interface
J6	F-51405 / F-51851 LCD Backlight Connector
J7	Optional Serial TTL Interface
J8, J9	7 – 20 VDC Input
J10	Optional RS232 Connector
J11	Touch Screen Connector
J12	Optional 5 VDC Input / Output

Table 3-4: Switches

Reference Designator	Function	Subsection
PB1	Programming	3.1.5

Table 3-5: J7 Pin Descriptions

PIN Name	PIN #	Type	Description
RxD	1	DIN	UART Receiver Input. This pin should be connected to the host UART TxD.
TxD	2	DOUT	UART Transmitter Output. This pin should be connected to the host UART RxD.
GND	3	PWR	Power Ground

Table 3-6: J8 Pin Descriptions

PIN Name	PIN #	Type	Tolerance	Description
VCC	1	PWR	7-20V	+7-20V Power Input
NC	2	-	-	Not connected. Leave open.
GND	3	PWR	0V	Power Ground

Table 3-7: J9 Pin Descriptions

PIN Name	PIN #	Type	Tolerance	Description
VCC	1	PWR	7-20V	+7-20V Power Input
GND	2	PWR	0V	Power Ground

Table 3-8: J12 Pin Descriptions

PIN Name	PIN #	Type	Tolerance	Description
VCC	1	PWR	5V	5V Power Input
GND	2	PWR	0V	Power Ground

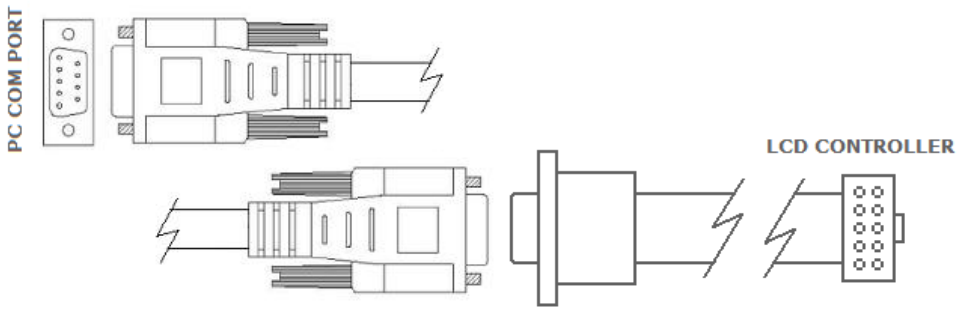
3.1.1. Jumpers Settings

Jumper between Pins 1 & 6 will force TC405/851 controller to the default (9600) baud rate.
Jumper between Pins 2 & 5 will supply unregulated voltage to the built-in voltage regulator on TC55471 controller. Use J8 or J9 to supply power to the voltage regulator.
Jumper between Pins 3 & 4 will supply power to TC405/851 controller from the external regulated power source through J12.
To supply 5 VDC to external application through J12 install jumpers on Pins 2 & 5 and 3 & 4.

3.1.2. Serial Communication

Communication with Touch Screen LCD Module through RS232 requires DB9MF serial cable and DB-9 to 10 Pin IDC adapter.

Figure 3-7: PC to TC405/851 Controller Connection



3.1.3. Baud Rate Settings

The TC405/851 controller has nine programmable baud rates. The TC405/851 controller is shipped set at 9600 baud rate. A baud rate is set by a command and stored. The baud rate can be changed at any time by removing jumper from Pins 1 & 6 on J5.

3.1.4. Contrast Regulation

The TC405/851 controller provides 7-bit fine contrast adjustment and rough adjustment through R11 trimmer potentiometer. The values provided in the TC405/851 controller should work in most cases, but it is possible that your particular design requires a different combination of fine or rough contrast adjustments.

3.1.5. Firmware Update

TC405/851 controller supports firmware updates. The utility for firmware update is included with the product, which also can be downloaded from http://www.tvielectronics.com. The new firmware for the TC405/851 controller can be downloaded at http://www.tvielectronics.com.
To enter the programming mode:

1. Turn off the TC405/851 controller board.
2. Press PB1 button on TC405/851 controller and apply power.
3. Release the PB1 button.
4. Start the utility to update firmware.

* Note: DO NOT power off TC405/851 controller while the firmware update is progressing, this may damage the TC405/851 controller.

3.2. TC405/851 COMMANDS LIST

- Text Mode

Print a single character:

Address								Data (ASCII)							
0	0	0	0	0	0	1	0	x	x	x	x	x	x	x	x

First character is Address 0x02, second - is ASCII Data for a character.

Print a string:

Address								Data (ASCII) or String Terminator							
0	0	1	0	0	1	1	0	x	x	x	x	x	x	x	x

The string starts with Address 0x26 followed by ASCII Data for every character. The max string size is 45 ASCII characters. For a string less than 45 characters, use a string terminator 0x0D.

- Graphic Mode

  To operate in Graphic Mode, the controller requires two characters per command.

Address								Data							
0	0	0	0	0	0	1	1	x	x	x	x	x	x	x	x

Address 0x03, Data - 8 bit for a desired graphic pattern

- XY Mode allows control of a single pixel as well as drawing shapes, such as rectangle and circle and horizontal, vertical or skew lines according to the entered coordinates.
  In a Pixel mode the controller will rewrite the contents of the display data RAM for a given pixel.
  (0,0) is a coordinate at the top left corner of the screen.
  (239,63) is a coordinate at the lower right corner of the screen.

  Pixel ON/OFF:

Address								Data							
0	0	0	0	1	0	1	0	x	x	x	x	x	x	x	x

X Coordinate								Y Coordinate							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Step 1: Address 0x0A, Data - number of coordinates in the string
Step 2: X (from 0 to 239), Y (from 0 to 63) coordinates

If the specified number of coordinates > 1, repeat Step 2.
For more than 128 (X and Y) coordinates, repeat Steps 1 & 2.

Overwriting the same coordinate will reverse a pixel on the screen (ON/OFF).

To draw a line:

Address								Data							
0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1E, Data 0x00, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - Start coordinate (X2,Y2) - End coordinate

To clear a line:

Address								Data							
0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1F, Data 0x00, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - Start coordinate (X2,Y2) - End coordinate

To draw a rectangle:

Address								Data							
0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1E, Data 0x01, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - upper left corner (X2,Y2) - lower right corner

To clear a rectangle:

Address								Data							
0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1F, Data 0x01, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - upper left corner (X2,Y2) - lower right corner

To draw a filled rectangle:

Address								Data							
0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1E, Data 0x02, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - upper left corner (X2,Y2) - lower right corner

To clear a filled rectangle or a specified area:

Address								Data							
0	0	0	1	1	1	1	1	0	0	0	0	0	0	1	0

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1F, Data 0x02, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - upper left corner (X2,Y2) - lower right corner

To reverse pixels of a specified rectangle:

Address								Data							
0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	1

X1 Coordinate Start								Y1 Coordinate Start							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

X2 Coordinate End								Y2 Coordinate End							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x1E, Data 0x03, Data X1, Data Y1, Data X2, Data Y2
(X1,Y1) - upper left corner (X2,Y2) - lower right corner

To draw a circle:

Address								Radius							
0	0	1	0	0	0	0	0	x	x	x	x	x	x	x	x

X Coordinate								Y Coordinate							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x20, Data R, Data X, Data Y
R - circle radius X,Y - circle center point

To clear a circle:

Address								Radius							
0	0	1	0	0	0	0	1	x	x	x	x	x	x	x	x

X Coordinate								Y Coordinate							
0	x	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x21, Data R, Data X, Data Y
R - circle radius X,Y - circle center point

- Specify Start page and column

  Start page:

Address								Data							
0	0	0	0	0	1	1	0	0	0	0	0	0	x	x	x

Address 0x06, Data x
x - page address from 0 to 7

  Start column:

Address								Data							
0	0	0	1	0	0	1	0	x	x	x	x	x	x	x	x

Address 0x12, Data x
x - column address from 0 to 239

- Select Screen font:

Address								Data							
0	0	0	1	0	1	0	1	0	0	0	0	0	x	x	x

Address 0x15, Data x
7 pixels (default): x = 1, 14 pixels: x = 2,
14 pixels Bold: x = 3, 22 pixels: x = 4

- Backlight:

Address								Data							
0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	x

Address 0x09, Data x
ON: x = 1, OFF: x = 2

- The touch screen controller can respond by sending X and Y coordinates of a touch screen contact location or by sending digits (if used as 6x3 keypad) to main microprocessor or computer. The TC405/851 controller can produce a sound on touch. In 6x3 Keypad Mode, the screen is divided on 18 boxes 37x18 pixels each. Controller sends digits from 1 to 18 according to the touch location. Each box response can be disabled or enabled. 6x3 Keypad Mode provides a Flip option

which reverses colors of the touched box. The TC405/851 controller provides a touch screen calibration routine for more accurate results. The controller responds with '$' character on touch screen release.

Touch screen in XY Coordinates Mode (allow 3% inaccuracy):

Address								Data							
0	0	0	0	0	1	0	1	0	0	0	0	0	0	x	x

Address 0x05, Data x
ON: x = 1, OFF: x = 2

Controller response:

X Coordinate								Comma							
x	x	x	x	x	x	x	x	0	0	1	0	1	1	0	0

Y Coordinate								String Terminator							
y	y	y	y	y	y	y	y	0	0	1	0	0	0	0	0

Example: x 0x2C y 0x20

Keypad Mode:

Address								Data							
0	0	0	1	0	0	1	1	0	0	0	0	0	0	x	x

Address 0x13, Data x
Keypad without Flip: x = 1, Keypad with Flip: x = 2, OFF: x = 3

Disable Specific Keypad Box

By default all 18 boxes are enabled.

Example 3-1: 6x3 Keypad Configuration

	MSB					LSB
Row 1	1	2	3	4	5	6
Row 2	7	8	9	10	11	12
Row 3	13	14	15	16	17	18

Address								Data Row 1							
0	0	1	0	0	1	0	1	0	0	x	x	x	x	x	x

Data Row 2								Data Row 3							
0	0	x	x	x	x	x	x	0	0	x	x	x	x	x	x

Address 0x25, Data Row 1, Data Row 2, Data Row 3
Example: To disable Boxes 1, 8, 15
Command: 0x25 0x1F 0x2F 0x37
Example: To re-enable all boxes
Command: 0x25 0x3F 0x3F 0x3F

Touch Screen Calibration:

Address								Data							
0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1

Address 0x19, Data 1

The calibration routine is provided to compensate for the normal touch screen variation. It is necessary to perform the software calibration of the touch panel after mounting the T/P onto your LCD.

You will be asked to touch three corners of the touch screen. A "Dot" along with comments will appear on the screen indicating where to make a touch. After successful calibration the controller will print "Done!" on the screen.

- Beep / Sound:

Address								Data							
0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1

Address 0x23, Data 0x01
The beep length is approximately ½ sec.

Beep on Touch:

Address								Data							
0	0	1	0	0	0	1	1	0	0	0	0	0	0	x	x

Address 0x23, Data x
Enable: x = 2, Disable: x = 3

- Display power save mode:

Address								Data							
0	0	0	0	1	1	0	1	0	0	0	0	0	0	x	x

Address 0x0D, Data x
ON: x = 1, OFF: x = 2

- Display background color

The TC405/851 controller supports multiple display modes (Normal, Reverse, Mixed) that can be freely mixed on F-51405 and F-51851 LCDs. Normal and Reverse Modes commands allow pixel ON/OFF state to be reversed without having to rewrite the contents of the display data RAM. Mixed Mode commands will rewrite the contents of the display data RAM. In order to clear the data RAM use a Clear Screen command.

Address								Data							
0	0	0	0	1	0	1	1	0	0	0	0	0	x	x	x

Address 0x0B, Data x
Normal: x = 0, Reverse: x = 1

Top (4 pages) Normal Bottom (4 pages) Reverse: x = 2
Top Reverse Bottom Normal: x = 3
Right (120 columns) Reverse Left (120 columns) Normal: x = 4
Diagonal from Top Right to Bottom Left: x = 5
Diagonal from Top Left to Bottom Right: x = 6

- Flip Page (Highlight):

Address								Data							
0	0	0	1	1	1	0	1	0	0	0	0	0	x	x	x

Address 0x1D, Data x
x - page number from 0 to 7

- Clear screen

  The Clear Screen command allows clearing of a single page or a whole screen.

Address								Data							
0	0	0	0	0	0	0	1	0	0	0	0	x	x	x	x

Address 0x01, Data x
x - page number from 0 to 7
x = 8 - whole screen

- Contrast

  The TC405/851 controller provides 7-bits of software contrast adjustment. The contrast value is stored and will default to the stored value.

Address								Data							
0	0	0	1	0	0	0	0	0	x	x	x	x	x	x	x

Address 0x10, Data x
x - from 0 to 127

- Animation

  The TC405/851 controller allows automatic alternation of images previously stored in Flash. Any command sent to the controller while animation is running will stop the animation and clear the screen.

Address								Delay							
0	0	0	1	1	0	1	1	x	x	x	x	x	x	x	x

Start Screen								Stop Screen							
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Address 0x1B, Delay - from 3 to 255 (each unit represents 100ms)
Start Screen - from 1 to 254
Stop Screen - from 2 to 255

- Set baud rate

  The baud rate value is stored and will default to the stored value.

Address								Data							
0	0	0	0	1	1	1	1	0	0	0	0	x	x	x	x

Address 0x0F, Data x
2400bps: x= 0, 4800bps: x = 1, 9600bps: x = 2, 14400bps: x = 3,
19200bps: x = 4, 28800bps: x = 5, 38400bps: x = 6, 57600bps: x = 7,
76800bps: x = 8, 115200bps: x = 9

- 4M bites of Flash Memory are divided into 2048 pages of 256 bytes each. The lower 40 pages of this memory contain text fonts used to display text. The remaining memory can be used to store up to 250 full-screen images. A utility program allows converting and downloading bmp and jpg images with 240x64 pixels resolution to display.

  Load screen from Flash:

Address								Data							
0	0	0	0	1	0	0	0	x	x	x	x	x	x	x	x

Address 0x08, x - from 6 to 255

Save current screen:

Address								Data							
0	0	0	1	0	0	0	1	x	x	x	x	x	x	x	x

Address 0x11, x - from 6 to 255

* The controller will respond with exclamation mark (!) 0x21 when ready for the next command.

4. PHYSICAL DESCRIPTION

This chapter contains the TC405/851 controller board's physical dimensions.

4.1. TC405/851 CONTROLLER BOARD PHYSICAL DIMENSIONS

- 134.9 mm (W) x 49.5 mm (H) x 23.3* mm (D) max
  * With DB-9 to 10 pin IDC adapter cable